
DEPARTMENT OF THE ARMY 02222.T
CORPS OF ENGINEERS, TULSA DISTRICT JAN 97

TULSA DISTRICT GUIDE SPECIFICATION

SECTION 02222

EXCAVATION, TRENCHING, AND BACKFILLING FOR UTILITIES SYSTEMS

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NOTE: This guide specification covers the requirements for excavation, trenching, and backfilling for utilities systems to the points of connection within 5 feet of the buildings. This guide specification is to be used in the preparation of project specifications in accordance with ER 1110-345-720.

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1 GENERAL

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NOTE: See Additional Note A.

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1.1 REFERENCES

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NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest change (Notice) to this guide specification.

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The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 422 (1963; R 1990) Particle-Size Analysis of Soils

ASTM D 1556 (1990) Density of Soil in Place by the Sand-Cone Method

ASTM D 1557	(1991) Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 10-lb (4.54-kg) Rammer and 18-in. (457-mm) Drop
ASTM D 2167	(1994) Density and Unit Weight of Soil in Place by the Rubber Balloon Method
ASTM D 2216	(1992) Laboratory Determination of Water (Moisture) Content of Soil and Rock
ASTM D 2487	(1993) Classification of Soils for Engineering Purposes
ASTM D 2922	(1991) Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)
ASTM D 2937	(1994) Density of Soil in Place by the Drive-Cylinder Method
ASTM D 4253	(1991) Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
ASTM D 4318	(1984) Liquid Limit, Plastic Limit, and Plasticity Index of Soils
ASTM D 4643	(1987) Determination of Water (Moisture) Content of Soil by the Microwave Oven Method

1.2 DEFINITIONS

1.2.1 Degree of Compaction

Degree of compaction is a percentage of the maximum laboratory dry density obtained by the test procedure presented in ASTM D 1557 or ASTM D 4253. ASTM D 1557 shall be used for soils containing 15 percent or more passing the No. 200 sieve (fines). ASTM D 4253 shall be used for soils containing 5 percent or less fines. The maximum laboratory dry density for soils containing between 5 and 15 percent fines shall be determined by the above procedure yielding the highest laboratory dry density. The percentage of material passing the No. 200 sieve shall be determined in accordance with ASTM D 4253. Degree of compaction shall be expressed as a percentage of the maximum laboratory dry density obtained by the appropriate procedure as defined above. Percentage of maximum laboratory dry density has been abbreviated hereinafter as percent laboratory maximum density.

1.3 SUBMITTALS

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NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.

Indicate submittal classification in the blank space using "GA" when the submittal requires Government

approval or "FIO" when the submittal is for information only.

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Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-09 Reports

Field Density Tests; [____]. Testing of Bedding & Backfill Materials; [____].

Copies of all laboratory and field test reports within 24 hours of the completion of the test.

2 PRODUCTS

2.1 MATERIALS

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NOTE: Satisfactory material will be defined in accordance with locally available materials, type of installation, etc., and all satisfactory classes will be listed in the contract specification in accordance with the Unified Soil Classification System (ASTM D 2487).

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2.1.1 Satisfactory Materials

Satisfactory materials shall consist of any material classified by ASTM D 2487 as GW, GP, CG, GM, SW, SP, SM, SC, and CL and shall be free of trash, debris, roots or other organic matter, or stones larger than 150 mm 3 inches in any dimension.

2.1.2 Unsatisfactory Materials

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NOTE: Unsatisfactory material will be defined in accordance with locally available materials, type of installation, etc., and all unsatisfactory classes will be listed in the project specification in accordance with the Unified Soil Classification System (ASTM D 2487). Normally stones larger than 3 inches are considered unsatisfactory.

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Unsatisfactory materials shall include materials classified in **ASTM D 2487**, as PT, OH, OL, ML, MH, and CH and any other materials not defined as satisfactory. Unsatisfactory materials also include man-made fills, refuse, or backfills from previous construction.

2.1.3 Cohesionless and Cohesive Materials

Cohesionless materials shall include materials classified in **ASTM D 2487** as GW, GP, SW, and SP. Cohesive materials include materials classified as GC, SC, ML, CL, MH, and CH. Materials classified as GM and SM will be identified as cohesionless only when the fines are nonplastic.

2.1.4 Rock

Rock shall consist of boulders measuring **1/2 cubic meter 1/2 cubic yard** or more and materials that cannot be removed without systematic drilling and blasting such as rock material in ledges, bedded deposits, unstratified masses and conglomerate deposits, and below ground concrete or masonry structures, exceeding **1/2 cubic meter 1/2 cubic yard** in volume, except that pavements will not be considered as rock.

2.1.5 Unyielding Material

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NOTE: Stones should generally not exceed 75 mm 3 inches in diameter. However, pipe manufacturer's criteria, if any, should be used.

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Unyielding material shall consist of rock and gravelly soils with stones greater than **[_____] meters [_____] inches** in any dimension or as defined by the pipe manufacturer, whichever is smaller.

2.1.6 Unstable Material

Unstable material shall consist of materials too wet to properly support the utility pipe, conduit, or appurtenant structure.

2.1.7 Select Granular Material

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NOTE: Maximum size of aggregate should be not more than 1 inch per foot of pipe diameter, or 3 inches maximum. Refer to pipe manufacturer's criteria for more stringent requirements, if any, on aggregate size and gradation.

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Select granular material shall consist of well-graded sand, gravel, crushed gravel, crushed stone or crushed slag composed of hard, tough and durable particles, and shall contain not more than 10 percent by weight of material passing a 0.075 mm No. 200 mesh sieve and no less than 95 percent by weight passing the 1-inch sieve. The maximum allowable aggregate size shall be [] mm [] inches, or the maximum size recommended by the pipe manufacturer, whichever is smaller.

2.1.8 Initial Backfill Material

Initial backfill shall consist of select granular material or satisfactory materials free from rocks [] mm [] inches or larger in any dimension or free from rocks of such size as recommended by the pipe manufacturer, whichever is smaller. [When the pipe is coated or wrapped for corrosion protection, the initial backfill material shall be free of stones larger than [] inch[es] in any dimension or as recommended by the pipe manufacturer, whichever is smaller.]

2.1.9 Plastic Marking Tape

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NOTE: The use of plastic marking tape for identification purpose will be mandatory for buried hazardous utilities such as electrical conduit, gas line, high pressure nitrogen, high pressure water line, domestic sewage force mains and industrial waste force mains, industrial sewers carrying hazardous, explosive or toxic waste. Tape should be used for all plastic or other nonferrous pipes and for ferrous pipes buried to depths such that the top of the pipe is more than 3 feet deep. Tape will be optional for nonhazardous utility lines such as domestic wastewater sewers (gravity) or storm drains.

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Plastic marking tape shall be acid and alkali-resistant polyethylene film, 152 mm (6 inches) 6-inches wide with minimum thickness of 0.102 mm (0.004 inch) 0.004 inch. Tape shall have a minimum strength of 12.1 MPa (1750 psi) 1750 psi lengthwise and 10.3 MPa (1500 psi) 1500 psi crosswise. The tape shall be manufactured with integral wires, foil backing or other means to enable detection by a metal detector when the tape is buried up to 900 mm 3 feet deep. The tape shall be of a type specifically manufactured for marking and locating underground utilities. The metallic core of the tape shall be encased in a protective jacket or provided with other means to protect it from corrosion. Tape color shall be as specified in TABLE 1 and shall bear a continuous printed inscription describing the specific utility.

TABLE 1. Tape Color

Red:	Electri
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Yellow:	Gas, Oil, Dangerous Material
Orange:	Telephone, Telegraph, Television Police, and Fire Communication
Blue:	Water System
Green:	Sewer System

3 EXECUTION

3.1 EXCAVATION

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NOTE: The details of disposal of excavated materials should be specified here. If dewatering is required due to ground water conditions, a paragraph on dewatering procedures and requirements should be developed.

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Excavation shall be performed to the lines and grades indicated. Rock excavation shall include removal and disposition of material defined as rock in paragraph MATERIALS. Earth excavation shall include removal and disposal of material not classified as rock excavation. During excavation, material satisfactory for backfilling shall be stockpiled in an orderly manner at a distance from the banks of the trench equal to 1/2 the depth of the excavation, but in no instance closer than 300 mm 2 feet. Excavated material not required or not satisfactory for backfill shall be removed from the site [shall be disposed onsite as directed by the Contracting Officer.] Grading shall be done as may be necessary to prevent surface water from flowing into the excavation, and any water accumulating therein shall be removed to maintain the stability of the bottom and sides of the excavation. Unauthorized overexcavation shall be backfilled in accordance with paragraph BACKFILLING AND COMPACTION at no additional cost to the Government.

3.1.1 Trench Excavation

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NOTE: The width of the trench below the top of the pipe will depend on the type of pipe used and soil conditions. The pipe manufacturer's installation manual should provide this information, and if so, it will be followed. In general, the width of trench will be 12 inches to 24 inches, plus pipe O.D. for smaller pipe sizes, and 24 inches to 36 inches plus pipe O.D. for larger pipe sizes. Sloping walls below the top of the pipe are allowed for certain types of pipe in special ground conditions.

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The trench shall be excavated as recommended by the manufacturer of the pipe to be installed. Trench walls below the top of the pipe shall be sloped, or made vertical, and of such width as recommended in the manufacturer's installation manual. Where no manufacturer's installation manual is available, trench walls shall be made vertical. Trench walls more than [] mm [] feet high shall be shored, cut back to a stable slope, or provided with equivalent means of protection for employees who may be exposed to moving ground or cave in. Vertical trench walls more than [] mm [] feet high shall be shored. Trench walls which are cut back shall be excavated to at least the angle of repose of the soil. Special attention shall be given to slopes which may be adversely affected by weather or moisture content. The trench width below the top of pipe shall not exceed 600 mm 24 inches plus pipe outside diameter (O.D.) for pipes of less than 600 mm 24 inches inside diameter and shall not exceed 900 mm 36 inches plus pipe outside diameter for sizes larger than 600 mm 24 inches inside diameter. Where recommended trench widths are exceeded, redesign, stronger pipe, or special installation procedures shall be utilized by the Contractor. The cost of redesign, stronger pipe, or special installation procedures shall be borne by the Contractor without any additional cost to the Government.

3.1.1.1 Bottom Preparation

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**NOTE: Stones 3 inches or greater should be removed.
However, pipe manufacturer's criteria, if any, should
be used.**

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The bottoms of trenches shall be accurately graded to provide uniform bearing and support for the bottom quadrant of each section of the pipe. Bell holes shall be excavated to the necessary size at each joint or coupling to eliminate point bearing. Stones of [] mm [] inches or greater in any dimension, or as recommended by the pipe manufacturer, whichever is smaller, shall be removed to avoid point bearing.

3.1.1.2 Removal of Unyielding Material

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**NOTE: Minimum of 4 inches should be removed to
produce a suitable cushion for the pipe.**

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Where unyielding material is encountered in the bottom of the trench, such material shall be removed 150 mm 6 inches below the required grade and replaced with suitable materials as provided in paragraph BACKFILLING AND COMPACTION.

3.1.1.3 Removal of Unstable Material

Where unstable material is encountered in the bottom of the trench, such material shall be removed to the depth directed and replaced to the proper grade with select granular material as provided in paragraph BACKFILLING AND COMPACTION. When removal of unstable material is required due to the fault or neglect of the Contractor in his performance of the work, the resulting material shall be excavated and replaced by the Contractor without additional cost to the Government.

3.1.1.4 Excavation for Appurtenances

Excavation for manholes, catch-basins, inlets, or similar structures shall be [sufficient to leave at least 300 mm 12 inches clear between the outer structure surfaces and the face of the excavation or support members] [of sufficient size to permit the placement and removal of forms for the full length and width of structure footings and foundations as shown.] Rock shall be cleaned of loose debris and cut to a firm surface either level, stepped, or serrated, as shown or as directed. Loose disintegrated rock and thin strata shall be removed. Removal of unstable material shall be as specified above. When concrete or masonry is to be placed in an excavated area, special care shall be taken not to disturb the bottom of the excavation. Excavation to the final grade level shall not be made until just before the concrete or masonry is to be placed.

3.1.1.5 Jacking and Boring

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NOTE: In situations where utility lines must be installed more than 15 to 20 feet below ground surface, through embankments, under minor roads or parking areas, or where surface conditions make it difficult or impractical to excavate open trenches, utility lines may be installed by jacking, boring, or tunneling as a contractor option. Where operational requirements preclude installation by trenching, the use of jacking, boring, or tunneling should be specified as mandatory alternatives. This requirement will normally exist where utilities must cross railroads, highways, primary access roads and airfield pavements. Pipe and conduit smaller than 36 inches in diameter will normally be installed in smooth steel pipe casing. Designing engineers must coordinate with installation facility engineers to identify and validate utility crossings where jacking, boring, or tunneling will be specified as mandatory.

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Unless otherwise indicated, excavation shall be by open cut except that street crossings of a trench shall be jacked or bored as follows:

Jacking or boring pipe shall be with approved procedures. Pipe and conduit smaller than 900 mm 36 inches in diameter shall be installed in a smooth

standard weight steel pipe casing. A minimum clearance of at least 50 mm 2 inches between the inner wall of the sleeve and maximum outside diameter of the sleeved pipe and joint shall be provided. Sand bedding shall be provided for the utility pipe or conduit through the sleeve. The Contractor shall submit the plan of his proposed installation procedures for approval. The plan shall include pipe guides, jack positions, jacking head, tunnel liner when required, jointing methods, and other specifics pertinent to the procedure selected.

a. Jackin

If the grade of the pipe at the jacking end is below the ground surface, suitable pits or trenches shall be excavated for the purpose of conducting the jacking operations and for placing end joints of the pipe. Wherever end trenches are cut in the sides of the embankment or beyond it, such work shall be sheathed securely and braced in a satisfactory manner to prevent earth caving. Construction shall be made in such a manner that will not interfere with the operation of the street and shall not weaken or damage any embankment or structure. During construction operations, barricades and lights to safeguard traffic and pedestrians shall be furnished and maintained, as directed by the Contracting Officer, until such time as the backfill has been completed and then shall be removed from the site. Heavy duty jacks suitable for forcing the pipe through the embankment shall be provided. In operating jacks, even pressure shall be applied to all jacks used. A suitable jacking head, usually of timber, and suitable bracing between jacks and jacking head shall be provided so that pressure will be applied to the pipe uniformly around the ring of the pipe. A suitable jacking frame or back stop shall be provided. The pipe to be jacked shall be set on guides, properly braced together to support the section of the pipe and to direct it in the proper line and grade. The whole jacking assembly shall be placed so as to line up with the direction and grade of the pipe. In general, embankment material shall be excavated just ahead of the pipe and material removed through the pipe, and the pipe forced through the embankment with jacks, into the space thus provided. The distance that the excavation shall extend beyond the end of the pipe depends on the character of the material, but it shall not exceed 2 feet in any case. This distance shall be decreased on instructions from the Contracting Officer, if the character of the material being excavated makes it desirable to keep the advance excavation closer to the end of the pipe. The pipe, preferably, shall be jacked from the low or downstream end. Lateral or vertical variation in the final position of the pipe from the line and grade established by the Contracting Officer will be permitted only to the extent of 1-inch in 10 feet, provided that such variation shall be regular and only in one direction and that the final grade of flow line shall be in the direction indicated on the plans. If the Contractor desires, he may use a cutting edge of steel plate around the head end of the pipe extending a short distance beyond the end of the pipe with inside angles or lugs to keep the cutting edge from slipping back onto the pipe. When jacking of pipe is once begun, the operation shall be carried on without interruption, insofar as practicable, to prevent the pipe from becoming firmly set in the embankment. Any pipe damaged in jacking operations shall be removed and replaced by the Contractor at his entire expense. The pits or trenches excavated to facilitate jacking operations shall be backfilled immediately after the jacking of the pipe has been completed.

b. Borin

The boring shall proceed from a pit provided for the boring equipment and workmen. Excavation for pits and installation of shoring shall be as outlined above under paragraph Jacking. The location of the pit shall meet

the approval of the Contracting Officer. The holes are to be bored mechanically. The boring shall be done using a pilot hole. By this method an approximate 50 mm 2-inch pilot hole shall be bored the entire length of the crossing and shall be checked for line and grade on the opposite end of the bore from the work pit. This pilot hole shall serve as the centerline of the larger diameter hole to be bored. Excavated material will be placed near the top of the working pit and disposed of as required. The use of water or other fluids in connection with the boring operation will be permitted only to the extent to lubricate cuttings; jetting will not be permitted. In unconsolidated soil formations, a gel-forming colloidal drilling fluid consisting of at least 10 percent of high grade carefully processed bentonite may be used to consolidate cuttings of the bit, seal the walls of the hole, and furnish lubrication for subsequent removal of cuttings and installation of the pipe immediately thereafter. Allowable variation from line and grade shall be as specified under paragraph Jacking. Overcutting in excess of 25 mm 1-inch shall be remedied by pressure grouting the entire length of the installation.

3.1.1.6 Stockpiles

Stockpiles of satisfactory [and unsatisfactory] [and wasted] materials shall be placed and graded as specified. Stockpiles shall be kept in a neat and well drained condition, giving due consideration to drainage at all times. The ground surface at stockpile locations shall be cleared, grubbed, and sealed by rubber-tired equipment, excavated satisfactory and unsatisfactory materials shall be separately stockpiled. Stockpiles of satisfactory materials shall be protected from contamination which may destroy the quality and fitness of the stockpiled material. If the Contractor fails to protect the stockpiles, and any material becomes unsatisfactory, such material shall be removed and replaced with satisfactory material from approved sources at no additional cost to the Government. [Locations of stockpiles of satisfactory materials shall be [as shown] [subject to prior approval of the Contracting Officer].]

3.2 BACKFILLING AND COMPACTION

Backfill material shall consist of satisfactory material, select granular material, or initial backfill material as required. Backfill shall be placed in layers not exceeding 150 mm 6 inches loose thickness for compaction by hand operated machine compactors, and 200 mm 8 inches loose thickness for other than hand operated machines, unless otherwise specified. Each layer shall be compacted to at least 95 percent maximum density for cohesionless soils and 90 percent maximum density for cohesive soils, unless otherwise specified.

3.2.1 Trench Backfill

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NOTE: Most pressure tests require backfilling to at least 2 feet over the pipe with the joints and couplings left open for inspection.

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Trenches shall be backfilled to the grade shown. [The trench shall be backfilled to [600] [] mm [2] [] feet above the top of pipe or as

recommended by the pipe manufacturer prior to performing the required pressure tests. The joints and couplings shall be left uncovered during the pressure test.] [The trench shall not be backfilled until all specified tests are performed.]

3.2.1.1 Replacement of Unyielding Material

Unyielding material removed from the bottom of the trench shall be replaced with select granular material or initial backfill material.

3.2.1.2 Replacement of Unstable Material

Unstable material removed from the bottom of the trench or excavation shall be replaced with select granular material placed in layers not exceeding 6 inches loose thickness.

3.2.1.3 Bedding and Initial Backfill

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NOTE: Bedding is provided to level out any irregularities in the foundation and to assure uniform support along the barrel of each pipe section. Bedding is also constructed to distribute the load bearing reaction, due to the weight of the backfill material, around the lower portion of the pipe. If the pipe or conduit is placed directly on a flat or shaped foundation, delete "bedding" from the title and from any reference in the paragraph. If bedding will be specified, determine type and thickness and show on the plans. Specify compaction to 95 percent maximum density for cohesionless soils, and 90 percent maximum density for cohesive soils.

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[Bedding shall be of the type and thickness shown.] Initial backfill material shall be placed and compacted with approved tampers to a height of at least one foot above the utility pipe or conduit. The backfill shall be brought up evenly on both sides of the pipe for the full length of the pipe. Care shall be taken to ensure thorough compaction of the fill under the haunches of the pipe and around the pipe.

3.2.1.4 Final Backfill

The remainder of the trench, except for special materials for roadways, railroads and airfields, shall be filled with satisfactory material. Backfill material shall be placed and compacted as follows:

- a. Roadways, Railroads, and Airfields: Backfill shall be placed up to the elevation at which the requirements in Section 0225 EARTHWORK FOR ROADWAYS, RAILROADS, AND AIRFIELDS control. Water flooding or jetting methods of compaction will not be permitted.
- b. Sidewalks, Turfed or Seeded Areas and Miscellaneous Areas: Backfill shall be deposited in layers of a maximum of 300 mm 12-

inch loose thickness, and shall be compacted to at least 90 percent of laboratory maximum density. Areas to be paved and other areas indicated as requiring compaction suitable for paved areas shall be compacted to at least 90 percent of maximum laboratory density and 95 percent of maximum laboratory density for the applicable ASTM D1557 and ASTM D 4253 procedure, respectively.

Water jetting shall not be allowed to penetrate the initial backfill.] [Compaction by water flooding or jetting will not be permitted.] This requirement shall also apply to all other areas not specifically designated above.

3.2.2 Backfill for Appurtenances

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NOTE: The number of days the concrete is allowed to cure before backfilling the structure will depend on the type of mix and the concrete strength requirements specified. Three days would be considered as a minimum.

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After the manhole, catchbasin, inlet, or similar structure has been constructed [and the concrete has been allowed to cure for [_____] days], backfill shall be placed in such a manner that the structure will not be damaged by the shock of falling earth. The backfill material shall be deposited and compacted as specified for final backfill, and shall be brought up evenly on all sides of the structure to prevent eccentric loading and excessive stress.

3.3 SPECIAL REQUIREMENTS

Special requirements for both excavation and backfill relating to the specific utilities are as follows:

3.3.1 Gas Distribution

Trenches shall be excavated to a depth that will provide not less than 400 mm 18 inches of cover in rock excavation and not less than 600 mm 24 inches of cover in other excavation. Trenches shall be graded as specified for pipe-laying requirements in Section 02685 GAS DISTRIBUTION SYSTEM.

3.3.2 Water Lines

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NOTE: Minimum depth of cover will be that required for frost penetration in the region and for safe operation of the utility. For fire protection yard mains, reference is made to NFPA 24 for recommended depth of cover.

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Trenches shall be of a depth to provide a minimum cover of 600 mm 2 feet from the existing ground surface, or from the indicated finished grade, whichever is lower, to the top of the pipe. [For fire protection yard mains or piping, an additional [_____] inches of cover is required.]

3.3.3 Heat Distribution System

Initial backfill material shall be free of stones larger than 6 mm 1/4 inch in any dimension.

3.3.4 Electrical Distribution System

Direct burial cable and conduit or duct line shall have a minimum cover of 600 mm 24 inches from the finished grade, unless otherwise indicated. [Special trenching requirements for direct-burial electrical cables and conduits are specified in Section 16375 ELECTRICAL DISTRIBUTION SYSTEM, UNDERGROUND.]

3.3.5 Plastic Marking Tape

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NOTE: The use of plastic marking tape for identification purpose will be mandatory for buried hazardous utilities such as electrical conduit, gas line, high pressure nitrogen, high pressure water line, domestic sewage force mains and industrial waste force mains, industrial sewers carrying hazardous, explosive or toxic waste. Tape should be used for all plastic or other nonferrous pipes and for ferrous pipes buried to depths such that the top of the pipe is more than 3 feet deep. Tape will be optional for nonhazardous utility lines such as domestic wastewater sewers (gravity) or storm drains.

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Warning tapes shall be installed directly above the pipe, at a depth of [400] [] mm [18] [_____] inches below finished grade unless otherwise shown.

3.4 TESTING

Testing shall be the responsibility of the Contractor and shall be performed at no additional cost to the Government. Testing shall be performed by an approved commercial testing laboratory or may be performed by the Contractor subject to approval. If the Contractor elects to establish testing facilities, no work requiring testing will be permitted until the Contractor's facilities have been inspected and approved by the Contracting Officer. Moisture contents shall be determined in accordance with ASTM D 4643 and/or ASTM D 2216. If the ASTM D 4643 procedure is used, moisture contents shall be checked by the ASTM D 2216 procedure once per each 10 ASTM D 4643 tests. Field in-place density shall be determined in accordance with

ASTM D 1556 or ASTM D 2922. If ASTM D 2922 is used, in-place densities shall be checked by the ASTM D 1556 procedure at a frequency on one sand cone test for each 8 nuclear density tests and not less than one sand cone density test per lift. The sand cone test shall be performed adjacent to the location where a nuclear density test was performed to insure a proper correlation is established between the two density test procedures. When test results indicate, as determined by the Contracting Officer, that compaction is not as specified, the material shall be removed, replaced and recompact to meet specification requirements, at no additional expense to the Government. Tests on recompact areas shall be performed to determine conformance with specification requirements. The following number of tests, if performed at the appropriate time, shall be the minimum acceptable for each type operation:

Tests shall be performed in sufficient numbers to ensure that the specified density is being obtained. A minimum of one field density test per lift of backfill for every [60] [] m [200] [] feet of installation shall be performed. One moisture density relationship shall be determined for every [500] [] cubic meters [500] [] cubic yards of material used.

3.4.1 Moisture Content

Moisture contents shall be determined on materials obtained from each density sample location.

3.4.2 Optimum Moisture and Laboratory Maximum Dry Density

The laboratory maximum dry density shall be determined from materials obtained at a sand cone test location using the appropriate procedure specified in Part 1 above. When ASTM D 1557 is used, the optimum moisture content shall be determined. A minimum of one laboratory maximum dry density test shall be run each placement day or fraction thereof. Additional laboratory maximum dry density tests shall be run for each material change.

3.4.3 Displacement of Sewer

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NOTE: The trench should be backfilled to at least 2 feet.

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After other required tests have been performed and the trench backfill compacted to 300 mm 2 feet above the top of the pipe [the finished grade surface], the pipe shall be inspected to determine whether significant displacement has occurred. This inspection shall be conducted in the presence of the Contracting Officer. Pipe sizes larger than 900 mm 36 inches shall be entered and examined, while smaller diameter pipe shall be inspected by shining a light or laser between manholes or manhole locations, or by the use of television cameras passed through the pipe. If, in the judgement of the Contracting Officer, the interior of the pipe shows poor alignment or any other defects that would cause improper functioning of the system, the defects shall be remedied as directed at no additional cost to the Government.

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ADDITIONAL NOTES

NOTE A: For additional information on the use of all
CEGS, see CGES-01000 CGES GENERAL NOTES.

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